Two Thousand and Beyond

New Leadership

Michael Anastasio
(2002•)

As a DOE National Nuclear Security Administration laboratory with about 8,000 employees, Livermore has an essential and compelling core mission in national security and the capabilities to solve difficult, important problems. The Laboratory's exceptional scientific and technical staff is engaged in projects that make use of a wide range of special

A national resource

facilities and capabilities to meet a variety of important national needs—maintaining a safe, secure, and reliable nuclear weapons stockpile; preventing proliferation and fighting the war on terrorism; developing technologies for reliable, clean energy and for environmental restoration; and contributing broadly to the nation's science and technology base.

The Laboratory's responsiveness to national needs was vividly demonstrated in 2001. Ongoing research and expertise, prototype development, and field-testing enabled Livermore to respond quickly to the events of September 11. The Laboratory's tools and systems are contributing to homeland security.

Livermore's exceptional capabilities to advance scientific understanding are exemplified by the ASCI White supercomputer, the world's largest and fastest machine, delivered to Livermore in 2000 and contributing to efforts to maintain the nation's nuclear weapons stockpile. Terascale computing offers unprecedented opportunities for scientific discovery.

An array of 15 projectors (far left) is used to display the results of ASCI computer simulations in unprecedented detail on the Powerwall (above), a nearly 20-million-pixel screen. Scientists also use arrays of flat panel displays (left) in their work centers and individual offices to visualize the results of ASCI calculations.

ASCI White Arrives

During the summer of 2000, 28 moving vans carried the pieces of the world's fastest supercomputer, called ASCI White, from IBM's development facilities in Poughkeepsie, New York, to Livermore. To accommodate the sheer physical size of this massively parallel machine, together with its wiring and cooling system demands, the Laboratory had doubled the size (and the underfloor space) of the computer room in Building 451.

This latest addition to the Laboratory's computing resources was deployed in three parts, all of which shared versions of IBM's RS/6000 SP hardware technology. ASCI White consists of 8,192 central processor units clustered into 512 nodes. Intended for large, highly parallel batch jobs, the machine demonstrated a processing speed of 12.3 teraops (trillion operations per second), about 3 times more than any other available computer at that time.

ASCI White's arrival marked the successful third step in a five-stage plan by the Department of Energy to sponsor development of a 100-teraops supercomputer by 2004. Launched in 1995 as the Accelerated Strategic Computing Initiative (ASCI), this collaboration of Livermore, Los Alamos, and Sandia national laboratories with U.S. industry and academia was later renamed the Advanced Simulation and Computing program. The goal was to significantly improve capabilities to simulate with high resolution the performance of weapons in the nation's nuclear stockpile. ASCI, and hence the White machine, is one of the cornerstones of the Stockpile Stewardship Program of the National Nuclear Security Administration.

Effective use of a computer like ASCI White required sophisticated software and network support. Laboratory innovations to transfer and store the massive data sets generated by ASCI White simulation runs—and to analyze that data visually—enhanced the practical value of this machine. Locally designed tools enabled the efficient parallel storage of vast output files. And local software (called a terascale browser) displayed data visualizations on wall-size screens to allow faster interpretation of results and bug detection.

ASCI White's benefits were soon evident. Use of the machine for pioneering scientific simulations began even as component upgrades continued on ASCI White's nodes. By the spring of 2002, scientists at Livermore and Los Alamos, using separate approaches to parallel code development for ASCI White, successfully completed two of the most refined computer simulations ever attempted, the first full-system three-dimensional modeling of a nuclear weapon explosion. Livermore's simulation alone used more than 1,024 White processors and took 39 wall-clock days to run. The Los Alamos work, executed remotely at Livermore by using a secure network connection to New Mexico, took over 120 days. High-bandwidth connections to Los Alamos and Sandia, coupled with extensive user support services at Livermore, have allowed this machine to be used effectively by all three laboratories.

The ASCI White supercomputer needed a floor with an extra 2 feet underneath it to accommodate airflow, switches, and 40 miles of cable connecting all the computer nodes.

Specialists from Livermore and Los Alamos national laboratories deployed the Biological Aerosol Sentry and Information System (BASIS) for the 2002 Winter Olympics in Salt Lake City, Utah. BASIS was developed under the sponsorship of NNSA's Chemical and Biological National Security Program.

Defending against Terrorism

The events of September 11, 2001, lent new urgency to the Laboratory's efforts to apply its technologies, tools, and expertise to better prepare the nation to defend against terrorist use of weapons of mass destruction (WMD). The prospect of a devastating bioterrorist attack became even more real a few weeks later when a terrorist sent anthrax through the mail, killing a number of people. Livermore researchers were able to provide immediate help because they had begun addressing the threat of WMD terrorism long before September 11. As part of the National Nuclear Security Administration's Chemical and Biological National Security Program, the Laboratory takes a comprehensive approach to the problem, developing technologies and tools to counter threats and working closely with response agencies to ensure that the technological solutions meet real-world operational needs.

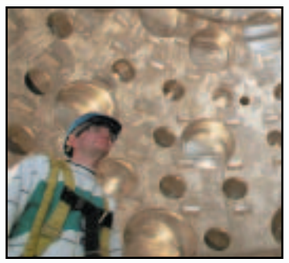
Post–September 11, the Laboratory provided analysis and assessments as well as information tools and expert personnel to the Intelligence Community. Livermore's Nuclear Threat Assessment Center operated seven days a week to evaluate numerous smuggling incidents and nuclear-related threats. In addition, the Counterproliferation Analysis and Planning System (CAPS), developed at Livermore and extensively used by the Department of Defense, supported U.S. military efforts with evaluations focused on sites of concern in and around Afghanistan.

As the anthrax mail cases illustrated, the U.S. is vulnerable to bioattack. Livermore technologies are at the core of the nation's biodefense capabilities. The Laboratory's miniaturized DNA analysis technology has been commercialized by Cepheid Inc. as the Smart Cycler and is being commercialized by Environmental Technologies Group as a handheld instrument. With both instruments, results are available in minutes. They are based on technology breakthroughs in biodetection instrumentation made by Laboratory researchers, who pioneered the miniaturization and ruggedization of DNA identification devices. In 1998, the technology was successfully demonstrated in field tests at Dugway Proving Ground, Utah, and an early version of the handheld instrument was delivered soon after to selected users.

In addition, the Biological Aerosol Sentry and Information System (BASIS), developed jointly by Livermore and Los Alamos, was deployed to Salt Lake City in 2001 as part of the overall security strategy for the 2002 Winter Olympic Games. Smart Cycler biodetectors are the heart of the BASIS field laboratory. Because biodetectors require unique antibodies or DNA sequences to identify and characterize pathogens, Livermore is also developing "gold standard" DNA signatures and assay protocols. They are then validated by the Centers for Disease Control and Prevention (CDC) and distributed by the CDC to the public health community.

The Laboratory is poised to make additional contributions to homeland defense through the development of more advanced technologies to defend against both current and future threats.

Livermore is developing an array of DNA pathogen signatures against which a biological-agent detector matches the samples it gathers. DNA signature development involves a multidisciplinary team of microbiologists, molecular biologists, biochemists, geneticists, and computer experts.



50 Years of Making History

Reflecting on the Past and Preparing for Tomorrow

Anniversaries are a time to reflect on one's accomplishments, learn from and be reinvigorated by them, and set goals for the future. The Laboratory's 50 years of accomplishments are a credit to the outstanding individual and team efforts of Livermore employees—now and in the past—in service to the nation. These achievements are indicative of a tradition of scientific and technical excellence that comes from being part of the University of California. The accomplishments would not have been possible without public support, funding from sponsors, and in numerous cases, the cooperative efforts of research partners. Livermore's principal sponsors have been the Atomic Energy Commission (1952–1975), the Energy Research and Development Administration (1975–1977), the Department of Energy, and now DOE's National Nuclear Security Administration (NNSA).

Commemorative events in 2002 contribute to the celebration of a rich 50 years of history, while other events during the year shape the Laboratory's future—new research facilities and capabilities as well as new leadership at Livermore.

On April 4, 2002, two groundbreaking ceremonies were held at Livermore. The $25-million International Security Research Facility will consolidate Livermore's nonproliferation and intelligence-related operations into a single building with cutting-edge information technology tools. The new facility will help the Laboratory meet the U.S. Intelligence Community's need for accurate and timely expert analysis about the proliferation of weapons of mass destruction. The demand for these assessments has accelerated since the September 11 attacks.

Groundbreaking also took place for the $92-million Terascale Simulation Facility, which will house Livermore's next-generation supercomputer in NNSA's Advanced Simulation and Computing (ASCI) program for stockpile stewardship. The 253,000-square-foot facility will include over one acre of computer floor and an office complex for 288 scientists and engineers. It will hold ASCI Purple, a machine capable of greater than 60 trillion operations per second, which is planned for delivery in 2004 and will keep Livermore at the forefront of terascale supercomputing.

On June 4, 2002, The Regents of the University of California appointed Michael Anastasio as Laboratory Director, effective July 1, 2002. He succeeds Bruce Tarter, who led the Laboratory through the establishment of the Stockpile Stewardship Program, tremendous growth in Livermore's experimental and computational capabilities, and rapid expansion of programs to counter the proliferation and use of weapons of mass destruction.

"First light" at the National Ignition Facility during the coming year will lead the Laboratory into its second half-century of service to the nation. With unique experimental facilities and computational capabilities, a vital national security mission, multidisciplinary capabilities able to address important, complex problems, and an outstanding work force, Livermore continues its tradition of being a "new ideas" laboratory. We are dedicated to ensuring national security and applying science and technology to the important problems of our time.

50 Years of Making a Difference